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TRANSLATIONS ON USSR ECONOMIC AFFAIRS

(FOUO 4/79)

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EFFICIENCY OF NEW TECHNOLOGY SCRUTINIZED

Evaluation of New Technology

Moscow VOPROSY EKONOMIKI in Russian No 2, Feb 79 pp 47-56

/Article by A. Konson, Leningrad: "Efficiency of Qualitatively New Equipment"/

/Text/ An evaluation of the economic efficiency of new equipment meeting qualitatively new needs of society is one of the most complex, urgent and less elaborated problems. Recently, the economic efficiency from the introduction of new equipment, in addition to the saving of the expenditures of national labor, has begun to include the satisfaction of various qualitatively new needs of society, for example, the possibility of receiving a color image on television screens, or of making more accurate measurements of some phenomena, improvement in the quality of output or services and so forth. Therefore, various qualitative components of the economic effect from the introduction of new equipment begin to acquire ever greater importance.

The further development of science is one of the components of the economic effect from the introduction of new equipment. New equipment helps to deepen our understanding of the laws of nature. The achievements in communication engineering, computer technology, quantum electronics and nuclear physics are largely determined by the development of the methods of and instruments for recording phenomena of short duration. Specialists working in these fields need reliable methods of obtaining data on the form and duration of various types of pulses (single, recurrent and step pulses changing in form, duration, amplitude and delay). Optical methods making it possible to expand the capabilities of measuring systems have recently penetrated more and more into the techniques of radio measurements. For example, in stroboscopic measurers, as a result of the use of lasers, the dynamics range increases and the degree of isolation between signal and gating circuits rises. The largest telescope, whose main mirror is 6 meters in diameter, in the world, developed in the Soviet Union, has enabled our astronomers to penetrate into outer space up to distances of several billions of light years. The light gathered by this telescope brings previously inaccessible information from the depths of the universe.

As applied to the same type of equipment the structure of the economic effect obtained from its introduction can greatly change in the course of time. Usually, the technical revolution is connected with the satisfaction of some qualitatively new need of society. After the creation of such equipment, as a rule, its subsequent developments are aimed at meeting this new need of society with the smallest possible expenditures, that is, at saving expenditures. Furthermore, provision is also made for further improvement in the quality of output in order to best meet this new need of society. This happens until a new technical revolution takes place in this field. Then the purposes of their developments and the economic effect obtained from their introduction again change.

As an example, the table shows the change in the structure of the economic effect obtained from the development of television broadcasting equipment.

Type of Developments	Structure of Economic Effect Obtained From These Developments
Development of the first transmitting and receiving black-and-white broadcasting television equipment	Satisfaction of qualitatively new social needs
Subsequent developments of black-and-white broadcasting television equipment	1) Reduction in expenditures of national labor (reduction in the cost of equipment and in the expenditures on its operation) 2) Improvement in the quality of output (improvement in the quality of black-and-white images on television screens)
Development of the first transmitting and receiving color broadcasting television equipment	Satisfaction of a qualitatively new need of society (providing the opportunity of seeing color images on television screens)
Subsequent developments of this equipment	1) Saving of expenditures of national labor (reduction in the cost of equipment and in the expenditures on its operation) 2) Improvement in the quality of output (improvement in the quality of images on color television screens)
Future developments, which will make it possible to make a qualitatively new leap, that is, to develop holographic color television	Satisfaction of a qualitatively new need of society (providing the opportunity of seeing three-dimensional color images on television screens)

Subsequent future developments of holographic color television equipment	1) Saving of expenditures of national labor (reduction in the cost of equipment and in the expenditures on its operation) 2) Improvement in the quality of output (improvement in the quality of images on color television screens with three-dimensional images)

A new technical revolution is expected in this field in time. Developments aimed at saving expenditures and at further improving the quality of output or services are carried out during the intervals between such technical revolutions. For example, the development of a portable color television set, which can be built into mobile facilities (such as a motor vehicle), opened up new opportunities of meeting qualitatively new needs by means of television. Obviously, after the appearance of color television a new technical revolution in man's way of life will be brought about by domestic video recording and reproduction equipment, which has begun to be intensively developed and improved recently. This equipment will make it possible to meet a qualitatively new need. It has been suggested that, when the price of video recording and reproduction equipment does not exceed the cost of a color television set, many consumers will consider its purchase economically efficient for them.

The determination of the economic efficiency of newly developed equipment or of a technological process should be preceded by a fuller description of the structure of the economic effect from their introduction. For example, as applied to airplanes the economic efficiency from the replacement of wire lines with optofiber lines lies not only in lowering their cost, but also in reducing the mass of connecting lines.

Often new equipment, ensuring the saving of expenditures, at the same time, gives a number of qualitative advantages, which as yet cannot be taken into account in the calculation of the economic efficiency from its introduction. In a number of cases new equipment makes it possible to gain several advantages. For example, the economic effect from the automation of laboratory equipment with the use of electronic digital computers includes the following: reducing the cost of an experiment or of a series of measurements; more rapidly obtaining the end result; increasing the productivity of experimenters' labor; improving the quality of data as a result of the elimination of subjective errors; obtaining a large volume of information during a short period; organizing experimental work, whose execution is impossible without the automation of equipment with the use of electronic digital computers.

Measurable and immeasurable indicators of economic effect are differentiated. However, not all the measurable indicators of effect can be expressed in a value form and compared with its other quantitative indicators. Along with

quantitative characteristics it is necessary to take into account all the components of effect that at this stage of scientific development do not yet lend themselves to a quantitative expression. For example, in cases where equipment gives a fundamentally different effect, meeting qualitatively new needs of society, for the selection of the most efficient variant it is by no means always possible to limit oneself to the indicators of reduced annual or specific reduced expenditures.

On the basis of new equipment it is possible to solve problems that could not be solved by means of previous equipment, or problems that could be solved, but less efficiently; could be solved, but more expensively; could be solved, but less efficiently and more expensively. For example, by means of artificial communication satellites it is possible to solve a number of problems. The solution of many of them was either completely inaccessible with cable systems, or was less efficient and more expensive. Such problems include the following: navigation and control of air traffic; communication with airplanes, ships and mobile ground stations; communication through vast water spaces or through poorly developed areas of dry land; radio and television broadcasting in sparsely populated regions. In such cases it is necessary to take into account in the comparable variants of equipment, in addition to expenditures, the qualitative differences in the effect obtained from it, that is, the different structure of the problems solved by means of it.

For example, it is impossible to determine the magnitude of the effect from the use of accelerators in oncological clinics. They guard people's health. The same also applies to the development of the artificial heart, which will be implanted in the human body and controlled by logic computer diagrams. Nor can the new effect obtained from this be given a cost evaluation.

The automation of the process of tests of manufactured output makes it possible not only to save labor expenditures, but also to improve the quality of tests (their accuracy and reliability), eliminating the effect of unstable subjective factors affecting results with manual tests. The introduction of developed forms of automation, in addition to saving expenditures, contributes to a reduction in the proportion of unskilled labor and to an increase in the proportion of skilled labor. The use of machine tools with numerical program control contributes to a reduction in the shortage of machine tool operators.

The use of vertical and short take-off and landing airplanes will shorten the time of air transportation over short distances, because passengers can be delivered directly from the center of one city to another without the use of ground transport. Furthermore, these airplanes make it possible to save time when passengers are transported from the airports of distant air lines to the city center and back. Much attention is now also given to reducing the noise of subsonic jet transport airplanes. New integrated diagrams have made it possible to increase the comfort of the color television set

owing to the possibility of lighting up the channel number and the precise time on the screen (or a separate indicator) and of realizing the idea of indication of fine tuning to meter and decimeter range channels by lighting up on the screen a scale in the form of a green band, whose length changes depending on the fineness of tuning. The installation of emergency communication telephones with automatic means of identification along roads will enable operators at the regional patrol station to clearly determine the location of the telephone from which a signal is received. Then they will be able to urgently send a technical assistance vehicle or an emergency rescue team there.

It is possible to cite many examples showing that more and more equipment making it possible to meet qualitatively new needs of society is now being developed. Of course, the following question arises: How to determine the economic efficiency of such equipment? There are several approaches to the solution of these complex problems. Each of the known methods can be used only under certain conditions. In some cases it is sufficient to simply change the number of some devices so that the same solution by the system of its technical (operating) problems may be ensured in each variant.

The unification in one system or instrument of functions previously performed by several instruments (systems) is one of the new advanced tendencies. For example, multifunctional laser systems both for welding and sewing microopenings have been developed. The combined automatic laser welding and drilling machine is used as follows: the welding part, for welding the components of microcircuits and miniature outlets, which are destroyed when other welding methods are used; the drilling part, for obtaining the tiniest openings in earthenware and pottery and in other fragile materials, which do not easily lend themselves to machining. Combined electronic wrist watches integrated with an electronic calculator have appeared. A combination of a clock and pulse measurer in one article has been developed. A combination of a calculator mounted in the body of a ball handle and a combined device including a pocket calculator (front) and a pocket dictaphone (back) have been manufactured. Radio receivers combined with magnetophones (combination radio-tape recorders) and an instrument combining a solar battery and a thermoelectric generator have been developed. Models of color television sets with built-in crystal clocks have been manufactured.

In cases where the expenditures on the operation of highly reliable articles can be disregarded, it is sufficient to compare the price of the combined device with the total prices of separate devices:

$$z_{ч/к} \geqslant (z_ч + z_к), \tag{1}$$

where $z_{ч/к}$ is the price of the combined wrist instrument (high-precision electronic watch-calculator); $z_ч$ is the price of the electronic watch; $z_к$ is the price of the pocket calculator.

If the price of the combined device is lower than the total prices of the separate devices, the saving of the reduced annual expenditures obtained with the introduction of the combined watch-calculator instrument will be

(rub./year):
combined
instrument

$$\Delta W_{n.r3} = \varepsilon_n [(z_u + z_k) - z_{uk}], \qquad (2)$$

where ε_n is the norm of efficiency of additional capital investments, 1/year.

If, however, for comparable variants it is necessary to calculate both capital investments and operating expenditures, the saving of reduced annual expenditures in the variant of the combined device is determined as follows:

(rub./year):
combined
device

$$\Delta W_{n.r3} = [(E_c + \varepsilon_n K_c) + (E_n + \varepsilon_n K_n)] - (E_k + \varepsilon_n K_k), \qquad (3)$$

where E_c are the annual expenditures on the operation of the automatic laser welding machine; K_c are the capital investments in the automatic laser welding machine; E_n are the annual expenditures on the automatic laser machine for sewing openings; K_n are the capital investments in the automatic laser machine for sewing openings; E_k are the annual expenditures on the operation of the combined automatic laser machine for welding and sewing openings; K_k are the capital investments in the combined automa ic machine for welding and sewing openings.

In some cases it is possible to reduce the comparable variants of equipment to the same volume of output produced by means of it. Often, however, such an equalization of variants is not necessary. To calculate the difference in the annual productivity of equipment, the specific, not absolute, measurers of expenditures can be compared.

Sometimes it is possible to equalize variants according to the paramater that ensures the derivation of a qualitatively new effect. Indicators for two comparable variants of a design are presented in the table /see following page/.

As compared with the base (first) design the expenditures in the new equipment variant increased: $K_2 > K_1$; $E_2 > E_1$; $W_{n.r2} = E_2 + \varepsilon_n K_2 > W_{n.r1} = E_1 + \varepsilon_n K_1$. However, it does not follow from this that the new model of the instrument is less refined than the base model only because it requires greater reduced annual expenditures $W_{n.r2} > W_{n.r1}$, that is, $W_{n.r1} = \min$. After all, in the base, cheaper, instrument the accuracy of measurement is also lower $A_{n1} < A_{n2}$.

Therefore, when evaluating the economic efficiency of a new design, it is necessary to take into account both of the mentioned circumstances. Sometimes this is possible when equalizing comparable designs according to the numerical value of a certain parameter (in this case, the accuracy of measurement). For this purpose the investments ΔK_y on the development of a more complex measuring scheme, by means of which a higher accuracy of measurement A_{n2} could also be obtained in this variant, are added to the capital investments K_1 in the first variant of the design (less precise instrument). At the same time, the expenditures ΔE_y resulting from the fact that the measurement with accuracy A_{n2} with the use of the less precise instrument (first variant) will require more time and, therefore, greater expenditures must be added to the operating expenditures E_1.

(1) Наименование показателей	1-й вариант конструкции (базовый) (2)	2-й вариант конструкции (новый) (3)
Существенный качественный параметр техники (в данном примере — точность измерения) (4)	A_{n1}	A_{n2}
Капитальные вложения (5)	K_1	K_2
Эксплуатационные расходы (6) . . .	E_1	E_2
Приведенные годовые затраты . (7) .	$W_{n.r1} = E_1 + \varepsilon_n K_1$	$W_{n.r2} = E_2 + \varepsilon_n K_2$

Key:

1. Name of indicators
2. First variant of the design (base)
3. Second variant of the design (new)
4. Important qualitative equipment parameter (in this example, accuracy of measurement)
5. Capital investments
6. Operating expenditures
7. Reduced annual expenditures

The reduced annual expenditures on the variants equalized according to the numerical value of the considered parameter A_{n2} total

(_____rub./year_____):
instrument solving the same
qualitative problems

$$W'_{n.r1} = [(E_1 + \Delta E_y) + \varepsilon_n (K_1 + \Delta K_y)] \geq W_{n.r2} = (E_2 + \varepsilon_n K_2), \qquad (4)$$

where $W_{n.r1}$ are the reduced annual expenditures on the base design of the instrument equalized with the new model in the accuracy of measurement. Thus, the selection of the most efficient design variant can be made on the basis of a similar comparison of expenditures. The difference in the numerical value of the qualitative parameter will be fully taken into consideration in expenditures.

When designing asynchronous electric motors, there is a need for an optimum combination of the efficiency η and $\cos\varphi$ of a machine in cases where the comparable variants of designs differ in these indicators, whereupon

$$\eta_2 > \eta_1; \qquad \cos\varphi_2 < \cos\varphi_1. \tag{5}$$

In designing practice attempts were made at solving this problem by determining the so-called energy coefficient of a machine equal to $\eta\cos\varphi$. At the same time, the variant in which the value of the energy coefficient was the greatest was considered the best in energy indicators:

$$\eta\cos\varphi = \max. \tag{6}$$

In reality, however, this coefficient gives little for the solution of the considered problem. The energy indicators for the two comparable variants of the design of an electric machine are presented in the table:

№ варианта	η	$\cos\varphi$	$\eta\cos\varphi$
1	0,80	0,85	0,68
2	0,85	0,80	0,68

Although the value of the energy coefficient in both variants is the same (0.68), nevertheless there is no basis for considering these variants equivalent. The energy coefficient creates only a semblance of solution of the problem. The considered problem can be solved correctly by equalizing comparable variants in $\cos\varphi$ to the value that exists in the variant with the higher $\cos\varphi$.

For these purposes for the variant of the electric motor with a relatively lower $\cos\varphi_2$ it is necessary to calculate the cost of compensating devices and the additional losses of electric energy in them. For this the cost $z_к$ of compensating devices should be added to the capital investments K_2 of the motor with a relatively lower $\cos\varphi_2$ and their depreciation and the losses of electric power in them $E_к$, to the operating expenditures E_2. Then both variants will be equalized in $\cos\varphi$ to $\cos\varphi_1$. The reduced annual expenditures on the second variant equalized in $\cos\varphi$ to $\cos\varphi_1$ will be

(rub./year)
electric motor

$$W'_{п.г2} = [(E_2 + E_к) + \varepsilon_п(K_2 + z_к)]. \tag{7}$$

Then it is possible to compare:

$$W_{п.т2} \leqslant W_{п.т1}. \tag{8}$$

If the new equipment (for example, an atomic reactor for an electric station) affects the environment, when reduced annual expenditures are calculated, it is necessary to take the expenditures on environmental improvement into account in capital investments and operating expenditures. In cases where comparable equipment variants have a different level of reliability the damage from the idle time of this equipment during repair must be taken into consideration in the operating expenditures on these variants.

The information recorded in integrated circuit memory units is usually lost when the power supply is cut off. Therefore, when comparing the capital investments on these memory units with the capital investments on ferrite core memory units, it is necessary to additionally take into account the cost of reserve battery supply and of the special disc accumulator. Then the capital investments in the variants of memory units equalized in their effect can be compared as follows:

$$(z_{зупс} + z_{б.п} + z_{д.н}) \leqslant z_{зуфс}, \tag{9}$$

where $z_{зупс}$ is the price of the integrated circuit memory unit; $z_{б.п}$ is the price of reserve battery supply; $z_{д.н}$ is the price of the special disc accumulator; $z_{зуфс}$ is the price of the ferrite core memory unit.

According to what technical parameters should comparable design variants be equalized? Sometimes it is suggested that they be equalized according to all technical parameters, which, in our opinion, is inadmissible. The advantages of the overwhelming majority of the parameters of developed equipment and often of all parameters are fully expressed in the calculation of the saving of reduced annual expenditures. The differences of many and sometimes of all the parameters of newly developed equipment are generalized in this indicator. Therefore, in each specific case it is important to correctly reflect in an economic calculation the difference of all the parameters of new equipment to which a monetary evaluation can be given. It may seem that in an economic calculation it is difficult to take into account an improvement in such a parameter as a reduction in the bulk of aircraft or ship instruments. Meanwhile, such a parameter can be given a monetary evaluation, for which it is necessary to calculate the additional annual net income (profit) derived from the transportation of an additional useful load as a result of the reduction in the bulk of an instrument.

According to what parameters shculd the variants of equipment, for example, of electronic digital computers, be equalized? Should the comparable variants of electronic digital computers be equalized according to the speed of operation? If a new electronic digital computer is characterized by a greater speed of operation, this will be reflected in the saving of specific

reduced expenditures ensured by it. Is it necessary to equalize equipment variants according to the level of reliability of equipment? In many cases the saving of reduced expenditures is the object of the increase in the reliability of equipment. Therefore, the difference in reliability will be expressed in monetary expenditures. More reliable equipment will ensure the saving of specific reduced expenditures. Thus, when an improvement in some equipment parameters (for example, speed of operation or reliability) is reflected in the saving of reduced expenditures, it is not necessary to equalize comparable design variants according to these parameters.

Recourse to an equalization of variants according to some technical parameters should be made only in cases where the difference of parameters makes it possible to obtain a qualitatively new effect, which cannot be evaluated in monetary terms. In such cases, in addition to reduced expenditures, for comparable variants it is also necessary to take into account the differences in the numerical value of some technical parameter. In order to make the comparison of expenditures alone possible under these conditions, it is advisable to equalize variants according to this parameter in advance.

Of course, it is by no means always possible to implement the equalization of variants in practice. Sometimes it is simply impossible to attain the value of the considered parameter (for example, the precision of an instrument) that was obtained in the latest design. Therefore, in such cases the advantages of the new instrument cannot be evaluated by the ordinary indicator of the saving of reduced annual expenditures or of the saving of specific reduced expenditures.

If some operating parameter of new equipment, which is of great independent importance (for example, the precision of a laboratory instrument or the quality of an image on a television screen), is improved and it is impossible to equalize designs according to the numerical value of this parameter, it is advisable to calculate the indicator of relative efficiency ε_o of additional expenditures connected with an improvement in this parameter in the new design:

$$\varepsilon_o = \frac{\Delta A_{n.y}}{\Delta W_{n.r.a}}, \tag{10}$$

$$\Delta A_{n.y} = \frac{A_{n2} - A_{n1}}{A_{n1}} 100\%, \tag{11}$$

$$\Delta W_{n.r.a} = \frac{W_{n.r2} - W_{n.r1}}{W_{n.r1}} 100\%, \tag{12}$$

where $\Delta A_{n.y}$ is the improvement in the considered operating parameter (in % of its initial value in the previous design); $\Delta W_{n.r.r}$ is the relative increase in reduced annual expenditures on an improvement in this parameter (in % of their initial amount).

Improvement in the examined parameter $\Delta A_{n.y}$ will be justified with

$$\varepsilon_0 > \varepsilon_{0.n}, \tag{13}$$

where $\varepsilon_{0.n}$ is the norm of relative efficiency of the additional expenditures connected with an improvement in the considered parameter.

The maximum permissible values of the magnitude of $\varepsilon_{0.n}$ should be set with regard to certain parameters of various types of equipment on the basis of the study of factual data. The principles of determining the magnitudes of $\varepsilon_{0.n}$ need an additional study. However, even where as yet there are no normatives of $\varepsilon_{0.n}$, the calculation of the indicator ε_0 often makes it possible to disclose cases where new equipment is obviously efficient (the magnitude of ε_0 is much higher than a unit) or inefficient (the magnitude of ε_0 is much lower than a unit).

In a number of cases the minimum specific price z_y per unit of the main equipment parameter is the criterion for the selection of a variant ($\frac{\text{rub.}}{\text{unit of main parameter}}$):

$$z_y = \frac{z}{p_z} \tag{14}$$

where z is the price of a device; p_z is the main technical parameter of this device.

This indicator is used successfully in cases where the operating expenditures in comparable equipment variants are insignificant or the same and capital investments are reduced to the price of equipment. For inertial aircraft navigation systems it is important to ensure a low magnitude of the ratio of the price of a system z to precision θ ($\frac{\text{rub.}}{\text{unit of precision}}$)

$$z_y = \frac{z}{\theta} \tag{15}$$

where z_y is the specific price of the inertial navigation system per unit of its precision.

The output of instruments and devices on acoustic surface waves for special use (for example, coordinated filters) is limited to small batches. However, the high price of these instruments is often justified by the unique operating characteristics. In some cases new equipment makes it possible to improve the quality of articles produced by means of it (or of the services performed by means of it). If this improvement in quality is reflected

in the prices of articles (or of services), it is possible to calculate the additional profit $\Delta D_д$ ensured in this case: (rub./year)/machine:

$$\Delta D_д = (z_{н.в} - c_{н.в})\, q_{г.в} - (z_{н.н} - c_{н.н})\, q_{г.н}, \tag{16}$$

where $z_{н.в}$ and $z_{н.н}$ is the price of a high-quality article produced by means of a new machine and of a low-quality article produced by means of a machine of the previous model respectively (rub./unit); $c_{н.в}$ and $c_{н.н}$ is the production cost of a high-quality article and of a low-quality article produced by means of machines of comparable types respectively (in rub./unit); $q_{г.в}$ and $q_{г.н}$ is the annual productivity of a new ($q_{г.в}$) and previous ($q_{г.н}$) machine respectively, by means of which different-quality articles are produced.

If the price ($z_{м2}$) of the new machine by means of which high-quality output is produced is higher than the price ($z_{м1}$) of the machine on which low-quality output is produced, the period of pay-off $\tau_{д.в}$ of additional capital investments $\Delta K_д$ in a new type of machine with the additional profit $\Delta D_д$ obtained from the sale of the output produced by means of it at wholesale prices will be (years):

$$\tau_{д.в} = \frac{\Delta K_д}{\Delta D_д} = \frac{z_{м2} - z_{м1}}{\Delta D_д}. \tag{17}$$

$\tau_{н.в}$ is the magnitude of reverse profitability of the additional capital investments $\Delta\rho_к$ in the considered machine (1/year):

$$\Delta\rho_к = \frac{1}{\tau_{н.в}} = \frac{\Delta D_д}{K_д}. \tag{18}$$

The result of calculation depends on how correctly the prices $z_{н.в}$ and $z_{н.в}$ are set for the articles produced by means of these machines. If, for example, the price $z_{н.н}$ is overstated, this will be reflected in an increase in $\tau_{н.в}$. In this calculation:

$$\tau_{д.в} = \tau_{н.в}(z_в) \tag{19}$$

where $z_в$ is the wholesale price of an article produced by means of the considered machine.

A similar calculation can also be made with respect to the new equipment that improves the quality of services met by means of it. For example, the additional profit brought by an airplane from the shortening of passenger flight time will total (rub./year)/airplane:

$$\Delta D_д = n_{д.в} n_{п.с} (s_{с.в} \Delta t_{о.р} N_{п.р} - \Delta e_{п.д} t_{с.г}), \tag{20}$$

where $\Delta D_{\text{д}}$ is the additional net income brought by an airplane; $n_{\text{д.г}}$ is the number of days during the year when the airplane makes flights; $n_{\text{п.с}}$ is the number of flights made by an airplane in 24 hours; $s_{\text{с.п}}$ is the price of 1 hour of saved passenger time, which the passenger is ready to pay in the form of an increment on the previous rate, a price accepted in this calculation (rub./passenger-hour); $\Delta t_{\text{п}}$ is the saving of time of one passenger during one flight (hour/passenger); $N_{\text{п.р}}$ is the average number of passengers transported during one flight; $\Delta c_{\text{п.г}}$ are the additional direct specific operating expenditures on a new type of airplane as compared with the previous type (rub./km); $l_{\text{с.р}}$ is the average distance of one flight (km/flight).

The period of pay-off $\tau_{\text{п.с}}$ of the additional capital investments $\Delta K_{\text{д}}$ in a supersonic airplane with the additional net income $\Delta D_{\text{д}}$ obtained from its operation will be (years):

$$\tau_{\text{п.с}} = \frac{\Delta K_{\text{д}}}{\Delta D_{\text{д}}}. \tag{21}$$

In practice it is not always possible to mathematically solve all technical and economic problems. Therefore, in the selection of the final design variant various methods of a qualitative technical and economic analysis also have an important role. Sometimes it is necessary to compare several variants of devices, each of which is characterized by qualitative advantages. At the same time, it is not possible to equalize such variants according to qualitative characteristics. There are several parameters in which these variants differ. The price of the output produced by means of the devices under consideration does not differ in these variants. In such cases all the qualitative parameters of devices are first compared and a variant in which their combination is the best is found. Afterwards for all the variants under consideration reduced annual expenditures are compared and the variant with the lowest expenditures is determined. In the end a generalizing conclusion is made as to which of the variants ensures the best combination of qualitative parameters and expenditures. At the same time, it is necessary to weigh to what extent the corresponding qualitative parameters are better in this variant and to what extent the reduced annual expenditures increase in it.

In some cases there is no analog for comparison. For example, in a number of cases a laser sewing of openings is the only possible technological process of obtaining small-diameter openings (from 2.5 μ to 1.5 mm, the ratio of the depth of an opening to the diameter being 50:1) in fragile ceramic materials, where drilling by other methods often leads to the crumbling of materials and to a distortion of sizes. Soviet contact microscopes do not have foreign analogs. They make it possible to investigate the cells of a living organism. By means of these microscopes, in which special lenses with a zero working distance are used, it is possible to observe and photograph the microstructure of live organs, as well as to follow the circulation of body fluids and of the substances introduced into it.

In such cases, when there is no analog for comparison, the economic substantiation of the design of a new device presupposes the following: calculation of the production cost and of the expected price of the designed device and a forecast of their reduction during various years of its output; calculation of all the other elements of capital investments with which the functioning of this device is connected and of the total amount of capital investments; calculation of the annual expenditures on the operation of this device; description of the qualitatively new needs of society that this device will make it possible to meet; conclusion as to whether the satisfaction of the qualitatively new need of society under examination can be considered acceptable with these expenditures and, primarily, with the wholesale price of this device.

The further elaboration of methods of evaluating the efficiency of new equipment producing a qualitatively new effect will contribute to the development of an important section of the theory of economic efficiency and will help investigators and developers of new machines, instruments, apparatus and systems in a correct economic evaluation.

Results of Utilization of Equipment

Moscow VOPROSY EKONOMIKI in Russian No 2, Feb 79 pp 57-67

/Article by L. Gatovskiy, corresponding member of the USSR Academy of Sciences: "Social and Economic Efficiency of New Equipment (Problems of Methodology)"/

/Text/ The national economic saving effect from the utilization of new equipment--in terms of its given socially useful result--forms the basis for and source of the increase in this result. The increase in socially useful results from the production and utilization of new equipment is an overall social and economic category. This objectively determines the existence of the category "social and economic efficiency of new equipment." It is characterized by the level of social and economic and socially useful results of the production and use of equipment, by the combined expenditures on the attainment of these results and by the relationship between results and expenditures. We will discuss the economic components of socially useful results of the production and use of new equipment and the social components that have a direct economic content.

First, the production use of new equipment affects the increase in the quantity, improvement in the quality and refinement in the structure of output and the material services rendered in the sphere of production, which fully applies to economic results. Second, the utilization of new equipment for consumer purposes is expressed in the growth of the end nonproduction consumption by the public of the output of material production and material services (increase in their scale and improvement in the quality and structure). These are social indicators, which have a direct economic content.

This includes the sale of all types of consumer goods and public services in the spheres of trade, public dining, housing and municipal facilities, transport, communication, household repairs and housekeeping. In this case the sphere of consumption appears as an element of the economic basis of society, entering as the concluding stage into the system of "production-distribution-exchange-consumption of material wealth." The consumption of the products of material production and material services is carried out in the nonproduction sphere as the end result of material production.

The other components of the socially useful results of equipment both for production and nonproduction purposes are social and do not have a direct economic content. These are primarily sets of social results directly connected with the protection of people's health and increase in their life span. Such are the social parameters of any equipment expressed in the indicators of its effect on the conditions and content of labor,[2] on the natural environment and on the development of public health as a sector.

The improvement in working conditions under the effect of new equipment and enrichment of its content are characterized by a very wide range of social indicators relative to overcoming the negative effect of the production environment on the human body and developing all the factors that intensify the favorable nature of its effect. The effect of new equipment on the social and economic processes of reduction of heavy physical labor and on such social phenomena as intensification of the elements of the creative principle in labor pertains here. In his speech at the 16th Congress of USSR Trade Unions L. I. Brezhnev stressed the following: "The party considers the technical retooling of industry, agriculture, construction and transport, for which vast sums are allocated, a decisive means of improving working conditions and of transforming all production facilities into safe facilities convenient for man." This is the national economic approach, which emanates from the interests of socialist society, to the social nature of the development of equipment, technology and organization of production and labor. A systematic realization of such ergonomic requirements is an inseparable element of the realization of the supreme goal of socialist production.

Social ecological indicators characterize the great effect (positive or negative) of new equipment on the state of air and water basins, soil, flora and fauna and, hence, on man's health and his living and working conditions, on the production processes of the enterprises located in this and other regions, on agriculture, the service sphere and so forth. An increase in the proportion of expenditures in the total amount of capital investments in social measures in the field of ecology is a natural process. A total of 11 billion rubles have been planned for these purposes during the 10th Five-Year Plan. The tasks of protecting the natural environment are realized in the appropriate direction of the scientific and technical policy as a whole and in the orientation of technology. "We are and will be developing the national economy," A. N. Kosygin pointed out in his report at the festive meeting devoted to the 61st anniversary of the Great October Socialist Revolution, "on the basis of the highest ecological demands corresponding to the nature of socialism."

The variant of every equipment selected for production must also be evaluated from the point of view of the demands for improving the conditions and content of labor and the environment. In our opinion, the corresponding indicators must be reflected in applied research and technical design problems, at all the stages of planning, design and experimental work, in technical specifications and prototypes, as mandatory detailed parameters in the practice of expert examinations and the certification of new equipment and in standarts.

Furthermore, the set of social results of the utilization of new equipment is expressed in the indicators of the growth of satisfaction of the people's spiritual needs and the creation, dissemination, utilization and consumption of spiritual values through the development of the material and technical base of the spheres of science, education, enlightenment, culture and the information connected with them.

The effect of scientific and technical progress on an increase in the population's free time as a factor in the growth of satisfaction of the people's material and spiritual needs holds a special place among the social results of scientific and technical progress. Improvement in the technical base of material production and the nonproduction sphere and in the organization of cultural leisure plays a key role in an increase in free time.

For greater clearness we will represent the general diagram of social and economic and socially useful results of the production and use of new equipment in the following form:

Production of New Equipment and Its Use in Material Production		Use of New Equipment in the Nonproduction Sphere	
Economic results	Social results not having a direct economic content	Social results having a direct economic content	Social results not having a direct economic content
Production of new equipment as means of production and consumer goods, output by means of new equipment and production services in the sphere of material production	Conditions of work and its content in the sphere of material production and the effect of material production under the influence of new equipment on the natural environment	Public consumption of the output of material production and the consumption of material services	Conditions and content of work, social ecological results, health protection and effect on the creation, dissemination and consumption of spiritual values

Thus, the socially useful results of the production and use of new equipment can be subdivided into three basic groups: a) economic results in the sphere of material production; b) social results having a direct economic content, because they pertain to the realization of the output of material production and material services in the nonproduction sphere and c) social results not having a direct economic content realized both in material production (this applies to labor protection and to social and ecological results) and in the nonproduction sphere. The last two groups form the sets of social and economic results of scientific and technical progress, which are directly connected with the realization of the supreme goal of socialist production and characterize the specific volume and qualitative level of satisfaction of certain material and spiritual needs of the public.

Such is the combination of the economic and social components of all the types of socially useful results of new equipment making it social and economic. This combination is based on the determining role of material production, scientific and technical progress and the increase produced by it in the combined productivity of national labor as the basis for the satisfaction of the material and spiritual needs of society. In the nonproduction sphere itself the realization of new equipment as the output of material production and object of material services plays the basic role in the totality of indicators of realization of the supreme goal of socialist production.

The development of material production and scientific and technical progress under present conditions presupposes a rapid increase in the role of the indicators of realization of new equipment in the sphere of nonmaterial services. This requires a growing utilization of new equipment in the processes of satisfying spiritual needs, improving working conditions and the natural environment and protecting health; for example, qualitatively renewing medical equipment. In particular, the following data attest to the urgency of this problem. In 1940 the ratio between the number of workers in the fields of public health, social insurance, public education, culture, science and scientific services and all the working population (without students) was 1:17, and in 1977, 1:6. During the indicated period the proportion of the number of workers in these spheres of nonmaterial services almost tripled and in the area of material services for the public, increased 1.5 times. The proportion of the number of workers in the nonproduction sphere (in addition to students) in the total mass of the working population increased from 11.7 percent in 1940 to 25.1 percent in 1977 (with an addition of the number of workers in trade and public dining directly servicing the public, approximately to 28 percent).

Scientific and technical progress serves as the basic factor in the realization of the supreme goal of socialist production, affecting this realization at all stages, beginning from the improvement in the production of means of production for the manufacture of means of production and ending with the development of consumption not for production purposes. Conditions have now increased for an ever greater direct orientation of scientific and technical progress toward a systematic growth of the people's

material and cultural (spiritual) standard of living and a constant improvement in their working and living conditions through an acceleration of the processes of outfitting all the spheres of the population's end production consumption with high-quality equipment. This has become one of the main conditions for the social and economic progress of the mature socialist society. As socialism becomes more mature, the objective need for and possibility of more fully realizing the supreme goal of socialist public production on the basis of scientific and technical progress becomes stronger. This goal itself is expressed in meeting the growing material and spiritual needs of society and in an all-around development of its members. Therefore, it is of social and economic nature not reduced to the sphere of the economy, which is reflected in the social and economic results of scientific and technical progress.

For every given new equipment the combined expenditures on obtaining a social and economic, as well as socially useful, result, including the combined expenditures on the attainment of new social parameters of equipment, correspond to this result. The assigned social and economic result for every technical measure presupposes iteratively performed calculations of the needs and resources (their saving) disclosing the realistic possibilities of meeting at the expense of the given equipment of specific volumes and a qualitative level some types of material and spiritual needs. This requires the utilization of the appropriate balances on the basis of a comparison of the envisaged improvements in results with minimized combined expenditures of resources. In this connection the investigations and developments of methods of evaluating the social significance of this need and of establishing the sequence and scale of its realization with due regard for the entire system of ranking needs are of the greatest importance.

The need during the selection of a variant of new equipment for following a single system of social and economic criteria, which combines the determination of the socially useful results (economic and social) obtained from new equipment and of the expenditures on attaining them, is objectively determined in the socialist society. This discloses the increase in the social and economic efficiency of new equipment, that is, its social and economic, as well as national economic, effect is determined. It has an overall content reflecting both the improvement in the social and economic result and the saving of expenditures. On the basis of such a premise, in our opinion, the social and economic, as well as national economic, effect of new equipment could be determined as the improvement in the social and economic result (expressed in qualitative and quantitative indicators of the growth of the volume of satisfaction of these types of society's needs) and reduction in the combined expenditures in terms of this given improved result obtained from it.

Thus, the social and economic, as well as national economic, effect is represented as a comparison of the growth of the social and economic result ($\Delta C\Theta^{p}_{н} \longrightarrow \max$) with a reduction in expenditures on the entire given (improved) result ($\Delta З_{н} \longrightarrow \min$) where $\Delta C\Theta^{p}_{н}$ is the growth of the social and economic result of new equipment as compared with base equipment[3] and $\Delta З_{н}$ is the reduction in expenses in terms of the entire given (increased) result of new equipment.

The variant of new equipment selected according to the minimum reduced expenditures is compared in expenditures with base equipment. The expenditures for particular equipment are calculated (according to the principle of the "identity of results") for the social and economic, as well as socially useful, result assigned for new equipment, including for the elimination or reduction of the negative social results inherent in base equipment (actually existing). The annual national economic effect is calculated according to the difference in reduced expenditures $(C + E_н K)$.

The social and economic effect of new equipment (including the selection according to this criterion) should be determined in an overall manner, singling out and then summing up individual components. Economic effect (difference in the reduced expenditures on the assigned socially useful result) is its first component. Other, subsequent, components characterize social results in comparison with the additional expenditures calculated for these results. Since the expenditures on various results can be compared and summed up, cumulative reduced expenditures on the assigned social and economic results are formed. The selection of a variant of new equipment is made according to the comparison of the cumulative reduced expenditures on base and new equipment. This can be depicted as $(З_{б_1} + З_{б_2} \ldots З_{б_n})$ $(З_{н_1} + З_{н_2} \ldots З_{н_n})$ where $З_{н_1}$ and $З_{б_1}$ are the reduced expenditures according to the basic economic function or base (б) and new (н) equipment and $З_{н_2} \ldots n$ and $З_{б_2} \ldots n$ are the reduced expenditures according to additional, social, parameters.[4]

Thus, when comparing the expenditures on base and new equipment, it is necessary to use the formula of reduced expenditures, first, without taking into account the additional social requirements placed on new equipment and, second, with due regard for them (the necessary additional expenditures are calculated). Then the obtained amounts of reduced expenditures are summed up separately for base and new equipment and the difference in these reduced expenditures is determined. At the same time, additional expenditures can be subdivided into costs corresponding to the accepted standard conditions and surpassing them.

Such a discrimination of social results in comparison with the expenditures necessary for them is of great fundamental and practical importance for the appropriate orientation in designing, planning, financing, controlling and calculating the development of positive social results and in reducing and overcoming negative results.[5] This places the increase in the economic interest in the realization of social results on a definite basis, because the volumes and qualitative levels of these results are determined and the expenditures on each of them are disclosed.

The national economic effect of new equipment is calculated for the sphere of consumption. This also applies to the realization of equimment in the nonproduction sphere. It is a matter of services for the public through public forms of consumption (public dining, household repairs, public health, such types of cultural services as film lending and so forth). The calculation should also be made in reduced expenditures (regardless of the fact

whether these units of the nonproduction sphere are economically accountable, or are entirely financed from the budget). This requires the organization of investigations, methodological studies and experimental checks of these problems, including systems of appropriate indicators, and regulation of the practice of their recording and planning. The saving of expenditures in the nonproduction sphere should be ensured by a rational organization of the utilization of resources provided it is mandatorily combined with an improvement in the quality of services and an increase in the population's free time. The assignments for expenditures in this sphere should be calculated for a constantly improved social result. The question of taking into account the saving of expenditures on the operation of new equipment in private consumption and housekeeping also deserves attention. Such saving should be taken into account in the calculations of the national economic effect of the given equipment.

In contrast to the category of expenditures in which unified measurers in value terms commensurable in natural and labor indicators actually exist, social results, expressing various social utilities, do not have unified measurers.[6] Here the results represent combinations of various components directed toward meeting a given need of society with the commensurability of the expenditures on obtaining these results and the possibility of summing up the expenditures.

The social and economic results of the production and utilization of new equipment are expressed (separately for every model or group of technical articles; for example, a system of machines) in volumes meeting the indicated needs. For example, with regard to the given technical articles in the simplest cases (meeting by means of this equipment one need for output or services; for example, the production and use of new equipment for a thermal electric power station) the social and economic effect can be expressed in the following set of indicators: P^{a} correlated to $З^{а}$, $P^{б}$ to $З^{б}$, $P^{в}$ to $З^{в}$ and so forth, where P^{a} and $З^{а}$ are socially useful results pertaining to the basic direct function of the given equipment (the production and utilization of energy), $P^{б}$ and $З^{б}$ are the results and additional expenditures on improving working conditions and $P^{в}$ and $З^{в}$ are the results and additional expenditures on the solution of ecological problems.

Sometimes the formation of indicators of the social and economic effect of new equipment is even simpler; for example, when it does not make changes in working conditions or in the improvement in the environment. It is possible to commensurate and sum up the results in the spheres of consumption of the output of material production, because the types of consumed output and their volume can be expressed in unified indicators. It is not possible to measure directly or indirectly the full content of the public utilities of social noneconomic results. Therefore, it is a matter of systems of indicators grouped according to individual types and directions of the social and economic, as well as socially useful, results of new equipment.

The exceptional complexity of the solution of all these problems is also connected with the fact that the use of this type of equipment often gives a number of results, which sometimes are opposite in direction. This applies to changes in working conditions, when a variant of new equipment improves some conditions and impairs others. The car, as the basic function, leads to an increase in free time, greatly improving living conditions and, at the same time, to negative ecological results and to the pollution of the air basin. It is a question of maximally increasing positive results and reducing negative results. It should be stressed that we are only at the initial stages of investigations, studies, comparisons and evaluations of the social results of the production and use of new equipment (as of all types of production). A great deal still has to be done for a scientific substantiation of criteria when setting priorities and orders, ranking needs and determining the scale and degree of their satisfaction, as well as for the further development of the methods of calculations of social results in an iterative comparison with the expenditures of resources.

Thus, all the indicators of the social and economic results of the production and use of new equipment, despite their differences, form a single complex and a combination of systems of indicators, because they are objectively connected as the components of the realization of the supreme goal of socialist public production. Therefore, they should be considered both separately and together in various groupings. The indicators of the growth of the social result of new equipment are of independent significance directly connected with the supreme goal of socialist production. This makes it necessary to establish a clearly pronounced system of social indicators characterizing the volume of satisfaction of a specific need for every new equipment realized in end nonproduction consumption.

A comparative analysis of the additional expenditures on base and new equipment for obtaining a social result assigned for new equipment on the basis of the fact that new equipment would require lower expenditures than base equipment is a necessary factor in the conventional calculation in favor of its selection. However, this does not eliminate another question: With the limitation of resources is it advisable (and on what scale) for society to incur these additional expenditures.

In the existing method of determining the economic efficiency of new equipment social results are considered only as a given value, in terms of which expenditures are calculated. The essence of this method lies in determining the economic effect as the saving of expenditures (according to the formula of the difference in reduced expenditures). However, this is only one aspect of the national economic effect. Another aspect, which characterizes the social and economic result reflecting the volume of satisfaction of society's needs, for the sake of which, in fact, the saving of expenditures is attained, is also very important. Consideration of such social and economic results obtained from new equipment and of their growth constitutes an independent problem, whose importance will increase. It is much more complex than the determination of the effect from the saving of expenditures. This

does not at all mean that, along with the existing method of economic efficiency, a special method of some "social efficiency" is necessary. It is a question of conducting investigations and studies of the development of the existing method in order that in the final analysis it may be transformed into a method of social and economic efficiency of new equipment with the presentation of both methods of determining the social and economic results obtained from new equipment and of organically connecting the saving of expenditures with them.

The national economic approach to social and economic efficiency is broader than the calculation of economic efficiency, because in the second case the calculation is made for the manufacturers and consumers of equipment and in the first case the effect of social results on other sectors and on the population of whole regions is also taken into account. This circumstance is taken into account when determining the social and economic effect, of course, with the observance of the principle of the "identity of results." In the interaction of the results of and expenditures on new equipment the saving of expenditures appears as a potential source of the growth of economic and social results. At the same time, social results affect economic indicators and the saving of expenditures (economic effect).

The problem of correlation of social and economic indicators has found various interpretations in our literature. For example, M. Vilenskiy, agreeing with the author that the social results of new equipment become an independent source of increase in its economic efficiency,[7] did not consider his evaluation of the place and role of the effect of social indicators on economic indicators correct. In our opinion, M. Vilenskiy in a certain sense assigned too broad a role to this effect as some global measurer of the social result. He believes that the quantitative indicators of the effect of the social results of utilization of new equipment on the economic effect of new equipment[8] (that is, in fact, on the saving of expenditures--L.G.) are their generalizing measure.

His conclusion that these results are entirely exhausted by the amount of the national income and its increase, whereupon positive social results increase the growth and negative results reduce it,[9] inevitably follows from this initial proposition, which, essentially, in large measure leads to the identification of social results with their effect on the saving of expenditures. In our opinion, M. Vilenskiy, in this case makes unsubstantiated abstractions twice. On the one hand, he disengages himself from all the other components of social results, apart from the effect on the saving of expenditures. On the other hand, he disengages himself from a comparison of social results with the additional expenditures on obtaining them, whereas these additional expenditures very often greatly exceed the amounts of savings from positive social results. Then the attainment of positive social results is accompanied by a reduction in the saving of expenditures and thereby by an increase in the national income. Taking into account all the social utility of new equipment not measured by economic indicators alone, society incurs such expenditures. At the same time, it also happens that with negative social results of new equipment a relatively high economic efficiency

is attained in connection with the lack of the appropriate expenditures. All this reflects the existence of contradictions between the social and economic indicators resolved by society.

No matter how great the positive effect of social results on a reduction in expenditures, increase in labor productivity and growth of output and of the volume of national income is, the extent of such an effect by no means reflects the entire public utility of these social results themselves. What cost, physical and labor indicators can quantitatively measure the entire social significance, for example, of the discovery of drugs capable of curing a previously incurable dangerous widespread disease? Of course, the entire social significance of the protection of people's health cannot be exhausted by the indicators of the effect of a decrease in morbidity on a reduction in expenditures connected with treatment, on an increase in the number of work days and on other similar economic indicators, although all of them are important and should be taken into account as accurately as possible. The public utility of social results under socialism is determined by the fact that man, his life, health and the satisfaction of his needs are an end in itself, which, of course, cannot be reduced to the saving of the expenditures of resources resulting from a reverse effect of social factors on economic factors.

The problem of inadmissibility of reducing social results to the saving of resources brought about by them is of great practical importance. Narrowing the content of these results, when only part of the components forming them is taken, cannot fail to affect the underestimation of social results during the selection of variants of new equipment. If the social (social and economic) result of the production and use of new equipment is understated, during a comparison with additional expenditures the social and economic benefit for society of the new equipment possessing high social parameters is understated artificially. This will occur inevitably if an incomplete social result, in which only part of the components forming it is taken, is compared with expenditures.

Calculation of the vast and, moreover, increasing effect of social factors on economic factors and the development of the methodology of such a calculation are of primary scientific and practical importance. Such a calculation still needs a significant intensification of the methodological base and is used in an extremely insufficient manner. This calculation should be utilized in a number of important directions--in the formation of the scientific and technical policy, determination of the rates and proportions of development of certain types of new equipment, substantiation of the selection of a variant of new equipment (comparison of the significance of its social result, required expenditures and the positive or negative effect of social factors on economic factors, including the national income).

Next, the indicated calculation should be used when establishing normatives for social results (including labor protection and improvement in the natural environment), in planned calculations of all types of resources and

in the compilation of labor and material balances. It is important that the effect of social results on economic indicators be sufficiently reflected in designing, standardization and certification, in financial plans, in the compensation of losses and substantiation of additional expenditures on social measures, in the calculations of their economic "return" and in the stimulation of overcoming negative social consequences and of increasing positive consequences.

In connection with the problem of measurability of the public utility of social results we will turn to such an overall and generalizing national economic indicator as the national income--this vital economic source of resources for the growth of the social and economic result and the implementation of scientific and technical progress (as well as of the entire public reproduction). The combined social and economic effect from scientific and technical progress is embodied (on a national economic scale) in the corresponding part of the increase in the physical volume of the national income (value terms in invariable prices). However, with all the exceptional importance of the national income as an overall indicator of the effect attained by the national economy, as a newly created value expressing socially necessary expenditures of labor, it cannot fully reflect the public utility of combined social results obtained from scientific and technical progress and from all public reproduction. This also applies to the physical volume of the national income in value terms in invariable prices. The public utility of social results that is beyond its value terms and is not reflected at all in the physical volume of the national income remains.[10] The realization of social results is much more reflected by such a category as the fund for the consumption of the national income uncovered in its physical and material structure. However, nor can a complete reflection of the public utility of social results realized in nonproduction consumption be attained here.

An absolute and relative increase in expenditures on obtaining social results, which, on the whole, is by no means covered by the saving of expenditures produced by these results, requires a corresponding increase in the economic effect from scientific and technical progress. First of all, this should be ensured by a significant increase in the proportion of highly efficient and fundamentally new equipment. At the same time, it is objectively determined that, as a rule, every new equipment should improve all the types of the social and economic result that are inherent in it in terms of specialization (including working conditions and ecological problems). Avoiding any impairment in social indicators is the minimum requirement.

Formulations of the so-called "averted damage" in the sphere of scientific and technical progress have received a certain popularization among economists. It is recommended that the economic effect from new equipment be summed up with the economically calculated effect from the elimination or reduction in damage and the negative consequences of technical progress. Such recommendations are objectionable. During selection new equipment is compared with base equipment according to the principle of the "identity of results"[11] and all

the positive results of overcoming the negative consequences of technical progress are taken into account in the results of and expenditures on new and base equipment (both among manufacturers and consumers). Therefore, no special, repeated, inclusion of the "effect from averted damage" during the selection of a variant of new equipment is needed. Of course, as already noted, economic calculations for overcoming damage should be made for many purposes.

The term "averted damage" cannot be considered quite successful owing to its lack of clarity. Sometimes it seems that the planned, not actually existing, negative consequences of technical progress are overcome. With such an approach, if one is to be consistent, any "noninclusion" in a plan of any possible negative results is "averting damage." Often the advocates of the position of "averted damage" greatly inflate the economic benefit from this "averting," permitting many conditionalities, especially in the part of "underreceived" output and profit, and often comparisons with additional expenditures and with base equipment are not made at all. Not to mention a recalculation, possibilities of creating a semblance of the obtained effect open up. Instead of the term "averted damage," apparently, the term "eliminated" damage would be more appropriate. Next, the term "damage" is not applicable to many social indicators. The concept of improvement in the social result is broader.

The selection of new equipment according to its social and economic effect makes the problems of ensuring its economically accountable profit for manufacturers and consumers (with due regard for additional expenditures on the attainment of social parameters, which often are not recovered during the periods of the output and service of this equipment) and of the appropriate organization of economic incentives especially urgent. The economically accountable social and economic effect obtained by manufacturing enterprises and the consumers of this equipment is based on the attainment of the established socially useful result (including the given social parameters--realization of output, services and work according to volume, structure and quality) while ensuring the saving of expenditures. The economically accountable effect is expressed in the indicators of the dynamics of profit and net profit.

There is an urgent need for an organization of a well-set up system of compensation of additional expenditures and losses and for the utilization of various forms of financing, stimulating and applying material sanctions in the field of protection of the industrial and natural environment. All this requires the solution of a number of problems of the sources and mechanism of formation and distribution of financial resources with due regard for the system of price formation. It is important to establish a clear differentiation of the sources of financing expenditures on the indicated social measures--budget sources, from the centralized funds of ministries and the funds of associations and enterprises. A systematic differentiation of social measures and their provision with respect to various facilities (enterprises--manufacturers and consumers of equipment separately, their collectives, workers in the nonproduction sphere, the population on a local and wider scale and so forth) are needed.

It is necessary to systematically toughen the standards on the protection of labor and the natural environment. When they are violated, material sanctions not only against enterprises (which is reflected in economically accountable indicators), but also against individuals guilty of these violations, are advisable.

A systematic solution of the problems of increasing the social and economic efficiency of scientific and technical progress is one of the important links in the economic strategy of the Communist Party on the basis of the decisions of the 24th and 25th congresses. These problems require an intensive development of the appropriate investigations in a unity with practice.

FOOTNOTES

1. The concept "social" is broader than the concept "economic," the latter being a variety of the former, which encompasses the basis and superstructure of society. However, there is also a narrower social concept as a direct expression of the realization of the supreme goal of socialist production. Singling out the category of the social result in this sense is of great fundamental and practical importance. Such an interpretation is given in this article.

2. These indicators reflect not only the effect on the physiological, but also on the psychological conditions of man's vital activity and, therefore, on the satisfaction of spiritual needs as well (satisfaction with labor, its attractiveness and an ever greater transformation of labor into a need connected with the development of personality).

3. Equipment taken for a comparison with new equipment according to the criterion of social and economic efficiency is meant by "base" equipment here and subsequently.

4. In special equipment designed for the realization of social problems $З_{с_1}$ and $З_{н_1}$ become superfluous and additional expenditures on social purposes become basic.

5. The development of methods of singling out in the expenditures on the manufacture of new equipment the elements that are newly introduced for the satisfaction of the social requirements realized in the processes of its production and operation, methods differentiated according to types of production facilities, is of great importance.

6. Here it is not a matter of the results of the effect of social results on economic indicators, which, of course, can be compared and summed up.

7. See "Metodologicheskiye Voprosy Opredeleniya Sotsial'no-Ekonomicheskoy Effektivnosti Novoy Tekhniki" /Methodological Problems of the Determination of the Social and Economic Efficiency of New Equipment/, Moscow, 1974, pp 34-35.

8. Ibid, p 34.

9. Ibid, p 35.

10. The effect from the scientific and technical revolution includes in a significant and rapidly increasing measure the social components of the satisfaction of people's needs, which cannot be taken into account by the indicators of growth of the physical volume of the national income. At the same time, the rapidly occurring processes of the emergence and satisfaction of new needs should be kept in mind.

11. The problem of compensating and stimulating additional expenditures on overcoming the negative social consequences of the utilization of equipment is of independent and very great importance.

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AGROINDUSTRIAL COMPLEX EFFICIENCY WEIGHED

Moscow VOPROSY EKONOMIKI in Russian No 2, Feb 79 pp 14-25

[Article by L. Kassirov: "The Efficiency of the National Economic Agroindustrial Complex"]

[Text] As was pointed out in L. I. Brezhnev's report at the CPSU Central Committee July (1978) Plenum, with the increased scale of agricultural production, the economic relations between the sectors of the agroindustrial complex have expanded and become more complicated, which objectively requires further improvement in the economic mechanism. The plenum set the party, planning and agricultural organs the task of paying more attention to questions of increasing production efficiency and improving the economic relations between the sectors of the agroindustrial complex. This task determines the urgency of working out the problem of indicators of the efficiency of the national economic APK [agroindustrial production complex].

In forming APK, in our opinion, one should take as the initial prerequisite certain theories according to which the efficiency of social production is measured and planned on the basis of principles common to the entire national economy, by comparing the results of the production (effect) with the expenditures or resources used; the indicators of the economic efficiency of agricultural production reflect the degree of use of the land, labor, material and financial resources.[1] Accepted as specific indicators of agricultural production efficiency are: the ratio of the effect, gross product (at comparable prices), net income and profit to the amount of land resources as the principal means of production in agriculture; the ratio of the profit of the kolkhozes and sovkhozes to the full production cost or to the average yearly value of the production capital (profitability), as well as the indicators characterizing the use of the main factors of increasing production efficiency (labor productivity, capital-labor ratio, etc.).[2]

The indicators enumerated are acceptable for the solution of current problems of intrasectorial estimates and planning. They are, however, clearly inadequate under today's conditions of the dynamic development of the

national economy, improving the economic methods of regulating the rates and proportions of expanded reproduction and raising the requirements for the criteria of qualitative growth. Under today's conditions the indicators of agricultural production efficiency are above all called upon to take into consideration the specific nature of the results stemming from the process of interfarm cooperation and agroindustrial integration. Used to determine the effect at all levels of the national economy are indicators of the gross product and its elements--the net and surplus products. At the same time, under the conditions of division and specialization of labor, the indicator of the value of the gross product and accordingly, other criteria of the effect calculated on the basis of it overstate the actual result due to duplicate counting of individual production of intermediate products and services and actually characterize amounts of the gross turnover combining the value of both the final and the intermediate output.

The development of interfarm cooperation and agroindustrial integration leads to broadening the exchange of results of the work within the sectors and associations, the scale of intraproduction turnover and to reducing the degree of separateness of different stages of economic operations. A substantial part of the economic relations that were earlier of a commodity nature are becoming intraproduction relations; the volume of the gross product taken account of is relatively reduced; an ever-increasing part of it goes into the production input of the complex or association.

Under these conditions, orientation toward increasing the volume of the gross product (essentially, the gross turnover) prevents concentration of efforts in the decisive directions. The gross product indicator characterizes the intermediate result as an independent element of the reproduction cycle, and it therefore does not provide orientation toward achievement of the optimum proportionality in the correlation of the final and intermediate product. Therefore, the methods used for taking account of the results of the work, with the present structure of collectivized production, do not reflect either the objective content nor the actual dynamics of the effect of the economic operations.

L. I. Brezhnev noted in the Report of the CPSU Central Committee to the 25th Party Congress that, "Administrative, and especially planning work should be aimed at the final national economic results. This approach becomes particularly urgent as the economic system grows and becomes more complex, when these final results depend increasingly on a large number of intermediate units and on the complex system of intrasectorial and intersectorial relations. Under these conditions, in the pursuit of intermediate results, which still do not in themselves decide the matter, it is easy to overlook the main thing--the final results. Conversely, if the proper attention has not been paid to certain intermediate units, the final, total effect of great efforts and large investments may be undermined." It follows from this that determining the effect under conditions of interfarm cooperation and agroindustrial integration at all levels of this process--from the national economic APK to the production units (associations and

interfarm enterprises)--presupposes a clear-cut demarcation of the indicators of the final and intermediate result, and ensuring the necessary proportions between them is an important prerequisite for increasing the efficiency of all social production.

A lack of such specific and substantiated indicators, differentiated with respect to the degree of readiness of the product for consumption (final or production--within the cooperative spheres, sectors and units of them) as a rule leads to an overstatement of the part of the effect being taken account of at the final stages of production and reduces the material interest in the intermediate results,[3] thereby hindering the development of the integrational processes. These tendencies are characteristic of both the structure of the entire national economic APK and of the intersectorial units of agriculture. In the latter they are intensified by separation and centralization of the incomes obtained by the interfarm enterprises and associations. Under these conditions, the farms lagging behind and the unprofitable sectors, which are in greatest need of using the advantages of interfarm cooperation and agroindustrial integration for uniting enterprises, prove to be the least desirable objects for cooperation.

Including the result of a certain specific unit of social production among the final or intermediate result depends, in the first place, on the functional role of the corresponding use values in satisfying social demands and, in the second place, on the position of this production unit in the system of the national economy. "... Whether a certain use value appears as raw material, labor resources or a product," wrote Marx, "depends entirely on its specific function in the labor process, on the place that it occupies in it, and with a shift in this place, its definitions also change."[4] The specificity of the content of the indicator of the final product lies in its relativity for different levels of economic operations. In each completed cycle, at a certain specific level of the organizational structure of production the final result is the volume of output that goes beyond the limits of the intraproduction turnover at the given level and the output used for nonproduction purposes.

Since the actual national economic result is determined by the amount of the final product, ascertainment of the real (from the standpoint of the whole society) effect should exclude the possibility of a duplicate count. The effect of a specific production unit is also expressed by its final product; the effect of the preceding stages is for it only the intermediate product (means of production). At each subsequent, higher level of the structural subdivision, the magnitude of the intraproduction (at the given level) turnover is again excluded. Therefore, the effect of the corresponding level of production is determined not by totaling the results of the preceding stages, but by the final product of this precise, and only this level. Consequently, in our opinion, the indicator of the final product, calculated individually for each given production level, should be taken as the initial value for determining the effect of production in

the present system of accounting and planning. From the standpoint of the direct economic tasks of society it serves as the main indicator of the result of the corresponding unit of the national economy.

The final product of the national economic APK as a whole, in contrast to the final product of its subdivisions (right up to the sector) has its own specific nature, determined by the structural content of the complex as a block of sectors of the national economy with a specific target function. The indicator of the final product of the farm, the association and the sector reflects as the minimum the entire volume of commodity production going beyond the limits of the given subdivision. Only the final product of sphere II (agriculture) belongs fully among the results of the APK, however. A considerable part of the work of the sectors of spheres I and III is not subordinated to the specific task of the agroindustrial complex and therefore, their result is not included in either its intermediate or final product.[5] The function of the agroindustrial complex is defined as the task of providing the national economy with food and agricultural raw materials, while including reserves and export resources. In accordance with this, the amount of the effect of each of its sectors and spheres that is related directly to the final product of the complex should be regarded as the effect of APK.

Therefore, without denying the purely economic significance of the gross product indicator, we consider it inexpedient to use this indicator as a criterion of the effect for conditions of interfarm cooperation and agroindustrial integration, that is, at least as the effect of the national economic APK. Since the APK is not the only consumer of the output of the sectors constituting sphere I, its final product may include only the portion of the results of the production infrastructure of agriculture that enters into the production use of spheres II and III. The final product of sphere I is realized in the value of the means of production supplied to agriculture and the units of sphere III and the production services rendered them. In other words, it is used in the form of resources within the APK and serves as an intermediate product for it. The part of the surplus product created in sphere I that is embodied in these means of production and production services, just as the additional incomes obtained through increased productivity of the means of production (or conversely, the possible losses from their obsolescence), should be counted in the price of the sale and reflected in the value (and this means, also in the amount of the effect of production) of the agricultural raw material and products of its processing.[6]

In addition, the part of the means of production of industrial origin used in spheres II and III transfers its value to the final product of these spheres gradually, in proportion to the depreciation, in the course of a series of production cycles. Therefore, their value is not fully included in the yearly final product of the APK, but only in the amount of the yearly value used, and it is counted in the costs of production of the final product in the form of amortization deductions.

The amount of the final product of the national economic APK produced in the course of the year, in value terms is thus the sum of: the net product formed in agriculture: the final product of sphere I, entering agriculture and the sectors of sphere III, in the amount of the actually used value (that is, of the amortization deductions from the value of the fixed capital of industrial origin, as well as the value of the productively used objects of labor obtained from the sectors of sphere I); the part of the newly created value in the corresponding sectors of sphere III during the processing and sale of agricultural products and raw materials (the rest of the final product of sphere III is counted in the output of agriculture received for industrial processing).

Planning and stimulating the obtaining of the effect by each (including the primary) subdivision of social production necessitates allowing for the indicators of the intermediate effect. The growth and optimization of the structure of intraproduction turnover is a compulsory condition for the development of production, its specialization and concentration and an increase in the final effect. In addition, as was noted above, the same result may be both intermediate and final, depending on its place in the system of social division of labor. L. I. Brezhnev, in the Report of the CPSU Central Committee to the 25th Party Congress, indicated the need to "give the consumer--whether it be a question of raw materials and materials, machines and equipment or consumer goods--broader opportunities to influence production." This signifies orientation of production toward the satisfaction of the demands not only of personal, but also of production consumption.

Carrying out this theory is urgent for all levels of social production, including the spheres, sectors and individual production units of the national economic APK. In particular, there must be more precise substantiation of the correlation between the growth rates of agricultural production and its material-technical provision; between the increase in purchases of agricultural products and raw materials and the production capacities of the procurement system and the processing industry; between the production of the output of livestock breeding and the production of fodder and development of the combined fodder industry; between the components of the fodders, mineral fertilizers, etc.

Certain specific elements of the means of production may be used productively only in a certain mutual correlation. If this correlation is not ensured, part of them, surplus and going beyond the boundaries of optimum proportions, cannot be put to use in the production of the final product of the corresponding period. In this case the production consumption volume is determined with respect to the minimum of the components of the proportion. The surplus part of the means of production may at best be regarded as production reserves, and at worst--if it is expended outside the optimum correlations--as nonproductive production costs.[7]

Balance in the volumes of the final and intermediate product is achieved by methods of planned and economic regulation of the growth rates with respect to the directions, units of production and types of products. The disproportions arising at a certain specific level of available resources and labor productivity may be eliminated by temporary stabilization of production for some sectors and types of output and accelerated development through freeing resources--for others. Within the limits of the proportions, established by the plan, between the final and intermediate product for a certain specific unit of social production, the importance of the corresponding types of effect is equivalent, and their evaluation and stimulation should in our opinion be based on unified principles.

The indicator of the net product, the main advantage of which lies in the fact that it reflects the magnitude of the newly created value, is being increasingly recognized in economic literature as a generalizing (complete) criterion of the effect of socialist production. At the same time, as is justly noted in a number of works,[8] the indicator of the magnitude of the net product does not characterize the degree of participation (share of certain specific units of social production) in providing for the demands of the national economy for specific material wealth and consumer values. Therefore, the material result and the value effect of production should be differentiated.

The material result is expressed by the final product and attests to the satisfaction of the final national economic demands for specific products of the work of certain specific production sectors. From the standpoint of satisfying these demands in the material, in-kind form, and this means, also for a description of the general material result, the correlation in the products of newly created and transferred value has no significance: both are embodied in the specific use value. It is another matter when it is a question of the value effect of production. In this case, this correlation is of decisive significance, since here one must single out from the value of the final product, in the first place, the results of the given production period, not counting the earlier created result (fund for replacing the means of production), which is a condition for the current and prerequisite for the succeeding stage of reproduction, and in the second place, the direct results of each specific unit of the national economy. After subtracting the quantities enumerated from the total result, the remainder is the economic effect, and accordingly, from the final product--the newly created value--the net product.

The need to differentiate the material result and the economic effect is caused by the dual nature of labor and the difference in its abstract and concrete content. The basis of the value of the final product is the amount of labor (live and embodied) socially necessary for its production, while the economic effect of each given production process is based only on the value newly created in this process by live labor. Equal live labor input at an identical level of its "skillfulness and intensiveness..."[9]

assumes the equal economic (value) effect of production; only live labor in its abstract content creates value. K. Marx noted that "The worker preserves the values of the means of production used or transfers them to the product as components of the value of the latter, not by the addition of his labor in general, but as the result of the particular useful nature, as the result of the specifically productive form of this added labor.... By the simple quantitative addition of labor, a new value is added, and as the result of the particular quality of the labor added, the old values of the means of production are preserved in the product."[10]

Live labor transfers to certain specific use values a different amount of past labor embodied in the means of production. This difference affects the overall value of the final product, but has no relation to the formation of the magnitude of the effect--it is related to the specific nature, "the specifically productive form" of the labor. Therefore, with identical live labor input, the material result in the production of different types of output is expressed in the different value of the final product. In other words, the overall material result is higher than the economic effect by the magnitude of transferred value of the means of production. This magnitude is not the same for different types of product. When, for example, M. Eydel'man takes the final product as the indicator of the effect, he thus, whether he wants to or not, excludes in advance the possibility of objective characteristics of efficiency both with respect to the types of product and to the level of production integration, that is, in both the horizontal and vertical aspects of the comparisons within the complex (the same thing is true of comparisons of the efficiency of the complex with other national economic sectors and formations).[11]

The indicator of the magnitude of the net product and national income reflects the goal of socialist production--the utmost rise in the material and cultural standard of living of the people--and characterizes the source of the consumption fund for the workers and resources for expanded reproduction. In this sense, the category of the net product should, in our opinion, be regarded as the criterion of the full effect. At the same time, the present level of working out the problem being discussed is still inadequate for formation of the sectorial characteristics of production efficiency on the basis of this criterion. There must be an additional analysis of a number of problems of a theoretical and methodological nature, particularly concerning the structural content of the criterion of the effect and the methodology for determining its elements.

The only source of expanded reproduction (the amount of its exceeding simple reproduction), as is generally recognized in Marxist-Leninist economic theory, is the part of the newly created value that is embodied in the surplus product. The efficiency of socialist production is expressed in an increase not only in the surplus, but also in the necessary product, but an increase in the latter, just as an increase in the entire consumption fund, also occurs due to purposeful use, conforming to the plan, of part of the surplus product: drawing into production additional labor masses and

increasing the expenditures involved in raising the people's standard of living are implemented through distribution of the surplus product of society.

The classical scholars of Marxism-Leninism pointed out that surplus labor and the surplus product should always exist and "the excess of the product of labor over the costs of supporting the labor, and the formation and accumulation of this excess of the social production and reserve fund--all this was and remains the basis of any social, political and intellectual progress," that "in any social production ... a distinction may always be made between the part of labor, the product of which is included in direct individual consumption by the producers and members of their family and ... the other part of labor, which is always surplus labor, the product of which always serves the satisfaction of the general social demands, no matter how this surplus product is distributed and no matter who functions as the representative of these social demands."12

The main proportion of expanded reproduction--between accumulation and consumption--is determined not only by the amount of the newly created value (the level of the necessary product for a certain specific period--the given magnitude), but also by the mass of surplus product. If, however, the optimization of the distribution of the surplus product is the objective condition for increasing production efficiency, and the national income emerges as the net product in already distributed form, then the surplus product itself (this means, its converted form too--the net income of society) should be singled out in the structure of the entire net product as the determining element of the effect, as the final effect of production.

Working out by elements the criterion for the effect also meets today's practical demands of guidance of the developed horizontal and vertical structure of the national economy. At the same time, for agriculture and the entire national economic APK it takes on primary significance. At present, at all levels of production--from the enterprise to the sector, inclusive--the result and, consequently, the effect (gross and net income, profit) are expressed not by the magnitude created, but only by the magnitude taken into consideration in the estimate with respect to the existing wholesale (purchase) prices. Meanwhile, the specific formational nature of the effect of agricultural production is determined by the considerable amount of excess surplus product (differential income) created in this sector. When the function of transferring the differential income to the state is fulfilled by the purchase prices, differentiated with respect to zones, depending on the differences in the objective production conditions of a certain specific product, part of the surplus product of agriculture is sold at the last stages of formation of the value and price of the finished product.

Therefore, part of the effect is related to the results of the sectors and spheres of the national economy that do not take part in creating it, and in the form of turnover tax on them enters the centralized fund of the

state's net income. Its separation and removal from ownership by a specified party with respect to the place of its creation results in the fact that the national economic effect takes into account an amount considerably exceeding the sum of the effect actually realized by all the physical production sectors. The calculation of the total profitability as one of the indicators of efficiency for the national economy of the country as a whole and also for the union republics, the full amount of the surplus product (profit and turnover tax) is included in the effect, but for the enterprises, associations and sectors--only the amount of net income (profit) realized by them. This is the reason for the lack of comparability of the national economic and the economic accountability efficiency.

The amount of the surplus product of the national economic APK as a value indicator of its final effect is quantitatively expressed as the difference between the amount of the total effect and the proportion of it used to compensate for the expenditures of the labor force in the amount of simple reproduction, that is, it is part of the surplus product of society created in the process of the production of agricultural goods, their processing and sale. This indicator also has an independent significance, since it characterizes the effect of APK as a real source of funds for the national economy for the needs of production accumulation and expanded reproduction of the labor force, the source of forming a centralized fund of the state's net income.

Modern methods of accounting and distributing the necessary product and the difference in the actual level of wages for the sectors of the national economy do not yet ensure the actual reflection of the amount and intersectorial proportions in the costs of reproduction of the labor force. Under these conditions the use of the indicator of the net product as an indicator of the effect reduces the objective significance of the characteristics of the efficiency in intersectorial comparisons. In addition, agriculture is the only major sector of physical production in which, due to the effect of technical progress, the number of workers employed is reduced not only relatively, but also absolutely. This process inevitably influences the dynamics of the effect accounted for as the magnitude of the newly created value (that is, including both the necessary and the surplus product).

If, furthermore, one takes into consideration the tendency toward a reduction in the indicator of the finial product as the result of the process of interfarm cooperation and agroindustrial integration, the use of data on the amount of net product as the effect will lead to a discrepancy between the dynamics of the indicator and the reality reflected by it: the progressive tendency of the primary increase in labor productivity as compared with the level of its wages, in itself attesting to an increase in production efficiency, will begin to be accompanied by a reduction in the indicators of the effect and the efficiency. Therefore, an indicator of the economic effect is needed that is least subject to the influence of the

above-noted factors and at the same time will objectively characterize the amount and dynamics of the effect at all levels of production. In our opinion, at present the most acceptable for this purpose is the final effect (net income).

It was noted above that the indicators of economic efficiency should reflect the degree of use of labor, material and land resources. As is known, the only source of the effect is labor. The capital-labor ratio and fertility of the lands used, however, affect its productivity and the magnitude of the effect. Therefore, in determining production efficiency, the economic effect should be compared not only with the live labor input, but with the entire aggregate of resources used. Because of this it becomes necessary to devise an integral indicator of production resources.

The special features and principles of forming the indicator of the effect of national economic APK determine the specificity of the methods of including the elements of production resources (by spheres of the complex) in their integral indicator. The effect of using the resources of sphere I is realized in the value of the means of production supplied to agriculture and the units of sphere III and the production services rendered them. Therefore, the final product of sphere I is used in the form of resources within the complex, that is, serves as an intermediate product for spheres I and II. It may be taken into account only within the means of production of these spheres and in the amount that reflects their real production potential. We will discuss the methods of including the components of the integral indicator in it.

According to the methodological regulations approved by decree of USSR Gosplan, the indicators of the economic efficiency of agricultural production should reflect the degree of use of the land, labor, material and financial resources.[13] In this connection the question arises as to the form of reflecting in the entire complex of resources an extremely important element of them such as labor resources, that is the masses of live labor used. If it is taken account of in the expenditure formula for determining profitability as an element of the production costs (expenditures for wages), then in the present (resource) formula, this decisive factor of production is essentially excluded from the calculation system. Calculation of this sort is unfounded, since the accounting of the funds itself is necessary only for the characteristics of the conditions of the functioning of labor and its capital-labor ratio without the mass of live labor using these means of production, and the indicator of available resources loses any real economic content.

The need to use the resource formula for efficiency for intersectorial formations, including for national economic APK, is logically substantiated. As is known, the transition from analysis of the intrasectorial relations (in the capitalist system of economics--competition) to intersectorial is for Marx accompanied by an analysis of the modification of the value for the price of production.

The expediency of taking account of the wage fund, along with the fixed and working production capital used, in the denominator of the formula for the efficiency was substantiated by a number of economists. The sum of these funds is used in calculations of the efficiency of the spheres of the national economy.[14] Since the mass of labor resources put into motion, in Marx's words, determines the amount of the wage fund,[15] it is expedient to take, as a commensurable (value) indicator of the labor resources used for agricultural enterprises, organizations and associations, the full sum of the yearly wage fund at the normative or base (for kolkhozes) level, as applied to the corresponding period, minus the part of the net profit of the enterprises distributed with respect to labor. At the same time, a regular rise in wages (estimated per unit of labor input) above the given level should be regarded as distribution and use of part of the surplus product for expanded reproduction of the labor force. For the sectors and enterprises of sphere II, one should take as this indicator the portion of the annual wage fund for their workers proportional to the relative proportion of the newly created value in processing and selling agricultural raw material in the total volume of the newly created value, or the net product of the given sphere.

Material-technical resources are included in the integral indicator as the sum of the value of the fixed production capital and the physical working capital (analogous to the content of the resources taken into account in the present formula for profitability), for agriculture--in the full amount, for sphere III--in the proportion calculated by the same method as the wage fund. In our opinion, in the future there may be a transition to estimating the fixed production capital with allowance for obsolescence and wear, that is, according to the regenerating value and minus the sums charged extra for amortization.

In estimates of the production efficiency of individual types of agricultural output, in view of the lack of substantiated methods of determining the actual capital-output ratio of the specific products, the value of the fixed production capital and of part of the physical working capital for the specific products may be calculated using the method of distribution of amortization charges adopted in the present practice of calculating the production cost.

At the present stage of study of the problem of including natural resources in the calculations of the efficiency it appears inexpedient to single out of the aggregate of these resources land funds as the main means of production in agriculture and the spatial basis of distribution of other sectors. As a rule, two extremes predominate in the recommendations for methods of determining agricultural production efficiency: in some cases the land funds in general are disregarded and are not included among the resources (for example, in the existing methodology for calculating profitability), and in the others, as was noted above, the effect is included only among this type of resources.

The need for commensuration of resources in an integrated form is determined by the fact that the land resources take part in agricultural production in a unified system with the rest of the production resources which have value and price. The possibility of this interpretation stems from the qualitative comparability of the means of production with respect to their functional role in the production process. If the natural conditions of the application of labor in agriculture and the quality of the lands are regarded according to the plan as a condition for achieving a certain specific magnitude of the effect, the lands themselves in their quantitative and qualitative characteristics emerge as a necessary element in the production resources that determine the capital-labor ratio of the labor, and thus, the level of production efficiency as well.

At the same time, including the effect only in the amount of the land resources is anadequate for solving the problem. The land serves as the main, but not the only means of production in agriculture. Therefore, the efficiency should be determined by comparing the effect not with any one element of the resources, but with the entire complex of them. In addition, allowance should be made for the fact that the nonuniformity of land, with respect to fertility, has an effect on the level of labor productivity on different lands: while as estimated per hectare of more fertile lands, the same effect was obtained as on a hectare of less fertile lands, this by no means indicates equal efficiency of the production in both cases. Therefore, both the amount and the quality (fertility) of the land resources must be taken into consideration. The most acceptable form of calculating the quantitative and qualitative differences in the lands used for the present may be their economic (value) estimate, comparable with the estimate of other resources used in the production process.

The lands of agricultural enterprises, organizations and associations are included fully in the integral indicator of the resources according to their economic evaluation; the lands occupied in sphere III--according to the data on the specific land-intensiveness[16] of the capital investments for the sectors of the given sphere and according to the level of the evaluation of one hectare in the corresponding zone (or on the average for the national economy--for calculations on the macro-level). Therefore, while the full accounting of the effect is the first prerequisite for ensuring the all-round nature of the efficiency indicator, a complete accounting of the resources, including the land resources, is the second necessary prerequisite. The integral indicator constructed on their basis with respect to form will be of the same kind as the profitability indicator. If, however, the latter as the relation of the profit, that is, of part of the effect, to the part of the resources used in production reflects only a comparatively narrow (often distorted) content of the efficiency, comparison of the full magnitude of the effect with the value estimate of all the resources used will make it possible to obtain more objective synthetic characteristics of the production efficiency.

The level of efficiency of APK, depending on the specific purpose of the characteristics, may be defined as the ratio of the complete or final effect to the integral indicator of the production resources. The indicators of the complete or final efficiency are used analogously. The full efficiency reflects the correlation of the values expressed in the actual prices and estimates of their sale. At present the final product is sold mainly by retail prices (food products and nonfood commodities produced from agricultural raw materials), and a substantial part of the production resources (their material-technical element)--by wholesale, procurement prices, and according to the production cost (the agricultural output received for production use within the sector). This situation causes a certain violation of the principle of quantitative proportionality, but in the process of improving the methods of taking count of the expenditures and resources it is completely surmountable. In addition, this lack of proportionality in calculating the effect and resources is also characteristic of other sectors of the national economy, and therefore it does not exclude intersectorial comparibility and the dynamic characteristics of APK as a whole. Therefore, the indicator of the full efficiency is applicable for measuring the overall level of APK efficiency and studying the dynamics and intersectorial comparisons (in the cross-section of the national economy).

At the same time, intrasectorial comparability of the levels of efficiency is of primary importance for optimization of the structure of the national economic APK, planning and stimulation of the development of its subdivisions, sectors and spheres. To solve these problems there must be an indicator of the final efficiency, in which the effect is expressed in the actual amount of the surplus product created at a certain specific level of production, not depending on the level of intermediate prices for sale and distribution processes.

There is at present still no statistical accounting for the complex as a whole and its spheres (with the exception of agriculture), which makes it difficult to determine a number of initial indicators for calculation of the efficiency. The components and general level of the corresponding indicators, however, may be revealed on the basis of the estimative data according to the present system of accounting. Given below are the form and results of ascertaining the indicators of the efficiency of national economic APK on the basis of the methodological theories set forth in accordance with the data for the Ninth Five-Year Plan (average annual indicators).

Improving the methodology, methodological bases and system of accounting of the economic results of national economic APK will make it possible to solve the fundamental problems of its formation from the standpoint of the most important economic criterion--production efficiency.

	APK as a whole	Including agriculture
Net income (in billion rubles)	62.5	42.3
including:		
sold by enterprises (in billion rubles)	18.3	9.2
transferred to state through system of zonal differentiation of procurement prices and sold in the form of turnover tax* (in billion rubles)	44.2	33.1
Aggregate wage fund estimated for final product (in billion rubles)	33.7	21.3
Net product (in billion rubles)	96.2	63.6
Integral indicator of resources (in billion rubles)	673.7	599.3
including:		
fixed production capital and physical working capital (in billion rubles)	240.0	180.0
economic evaluation of land* (in billion rubles)	400.0	398.6
Efficiency:		
total (in %)	14.3	10.6
final (in %)	9.3	7.1

* Calculated on the basis of the methodological studies of the Department of Agrarian Problems of Socialism of the Institute of Economics of the USSR Academy of Sciences. The other indicators in this table were determined from the data of the statistical yearbook "Narodnoye khozyaystvo SSSR za 60 let" [The USSR National Economy in the Course of 60 Years], Izdatel'stvo Statistika, 1977.

FOOTNOTES

1. See "Metodicheskiye ukazaniya k razrabotke gosudarstvennykh planov razvitiya narodnogo khozyaystva SSSR" [Methodological Instructions for Drafting the State Plans of Development for the USSR National Economy], Izdatel'stvo Ekonomika, 1974, pp 33, 205.

2. See "Metodicheskiye ukazaniya k razrabotke planov razvitiya sel'skogo khozyaystva" [Methodological Instructions for Drafting Plans for the Development of Agriculture], Izdatel'stvo Kolos, 1978, pp 247-250.

3. As an example we may allude to the comparatively low level of material incentive for the production of fodders as a typical intermediate product in agriculture; to the varying profitability of the stages of reproduction and fattening in livestock breeding; finally, to the lower degree of stimulation for the production of the raw products of agriculture than with the finished (final) products, manufactured from agricultural raw materials, where the excess part of the surplus product is withdrawn for the budget in the form of turnover tax.

4. K. Marx and F. Engels, "Soch." [Works], Vol 23, pp 193-194.

5. According to the unified classification adopted for the CEMA member countries, included in sphere I of APK are the sectors of the national economy that ensure the material-technical supply and service of agricultural production; in sphere II--strictly agriculture; in sphere III--sectors carrying out the processing and delivering to the consumer the finished products of agricultural origin.

6. An analysis of the execution of this theory goes beyond the framework of the problems discussed here.

7. For example, the normative ratio of nitrogen, phosphorus and potassium in mineral fertilizers on the average for the USSR is determined as a proportion of 1:1.1:0.8. In 1975 the actual supplies of fertilizer to agriculture provided a ratio of 1:0.6:0.7. As a result of the shortage of phosphorus fertilizers, the volume of effectively used fertilizers, on the basis of the supplies was: for nitrogen--58%, for potassium--47%. The rest of the nitrogen and potassium fertilizers could not be efficiently used. There is a similar ratio of power engineering and operating machines, tractors and trailer implements to the ratio of components in fodders, etc.

8. See, for example, G. Kiperman; Yu. Muntyan; and M. Polyakova, "Methodological Aspects of Planning and Accounting of the Final Results of Production" (VOPROSY EKONOMIKI No 2, 1977, p 38).

9. K. Marx and F. Engels, "Soch.," Vol 23, p 47. We are using this expression of Marx in order to avoid lack of precision in terminology in this case: labor productivity, as is known, is not comparable with respect to various use values.

10. K. Marx and F. Engels, "Soch.," Vol 23, pp 211-212.

11. See VOPROSY EKONOMIKI, No 4, 1975, pp 54-55.

12. K. Marx and F. Engels, "Soch.," Vol 20, p 199; Vol 25, Pt 2, pp 449-450.

13. See "Metodicheskiye ukazaniya k razrabotke gosudarstvennykh planov razvitiya narodnogo khozyaystva SSSR," Izdatel'stvo Ekonomika, 1974, p 205.

14. See VOPROSY EKONOMIKI, No 11, 1974, pp 116-117; IZVESTIYA AKADEMII NAUK SSSR. SERIYA EKONOMICHESKAYA, No 6, 1977, p 111, etc.

15. See K. Marx and F. Engels, "Soch.," Vol 25, Pt 1, p 157.

16. See V. A. Vashanov, "Demands for Lands for Industry (EKO, No 3, 1976, pp 95-99).

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